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The ASA (Approccio Sostenibile dell'Abitare) App.
A sustainable housing approach tool to raise tenants' awareness in the public housing sector

M Toni[1,*]

[1]Department of Architecture, University of Ferrara, via Ghiara, 36, Ferrara, 44121, Italy

*michela.toni@unife.it

Abstract. This research project introduces an innovative tool promoting participatory processes for sustainability in the Public Housing system where different players are involved. It deals with a specific learning process aiming at fostering a responsible behaviour by the occupants, and envisages calling in new Players, namely, senior Students from technical high schools, to act as trainers themselves and coach the Tenants through on-going meetings. An Application called ASA (Sustainable Housing Approach in English) will be developed to include the information provided by the Tenants about their family households and housing units during the coaching sessions, and collected by the student-coaches. The characteristics of the ASA as a knowledge and management tool intended to improve savings and wellbeing are described. Available on iPad and accessible to all Tenants in the training environment, the ASA can be downloaded to mobile devices. Talking of outcomes, the logical steps making up the ASA's dynamic process are outlined. The economic and social benefits for the different Players are outlined as well.

1. Foreword

To achieve positive sustainability outcomes, not only specific technological investments are required but also a responsible behaviour is the key. In the building field, in particular, in spite of the environment-friendly construction and plant-engineering solutions increasingly adopted to save energy and reduce the operating costs, significant results can be only achieved through the occupants' commitment. That's why, implementing permanent educational and training processes can make a crucial contribution.

The research project named ASA, the Italian acronym for Approccio Sostenibile all'Abitare (to say, a housing-sustainable approach), is described in this report. It deals with the development of a tool to raise the occupants' awareness on the critical role they can play through a sustainable housing model.

This project was inspired by a research experience in South Tyrol, an Italian region highly prone to building experiments, and home to IPES (Istituto per l'Edilizia Sociale della Provincia Autonoma di Bolzano, literally the Social Housing Institution for the Autonomous Province of Bolzano in English), the largest South Tyrolean building firm. This paper does not take into account the pioneering technological systems used by IPES in their projects nor the high-efficiency energy class IPES chose to adopt as a standard since their inception according to CasaClima's inputs well before they did become mandatory. Our research draws on IPES' experience because it definitely sheds light on the

emerging role the Public Housing Building can play while experimenting new tools to engage the occupants to beneficial behaviours which might result into reduced running costs, lesser pollution and improved living standards.

Therefore, the action area of this research project is Public Housing Building (ERP, Edilizia Residenziale Pubblica, in Italian), as this building segment often includes:

- very high-quality standards in terms of building techniques and building process management, despite the budget limits;
- an interesting range of family structures in terms of number of members, aggregation, and cultural identity.

The research outcomes could prove expedient also in other scenarios, both Italian and non-Italian, where establishments exist which manage huge building stocks in either the public housing or the social housing field. As a matter of fact, these outcomes could be exploited also in the private building in order to foster a cultural change by the owner-occupier's part. Also in this case, this tool would be a great asset for sustainability, both in economic and social terms [1].

2. Focus on a need
In the period Autumn 2017 to Spring 2018, an opportunity arose for the researchers to visit two public housing construction rehabilitation sites within the EU program "Sinfonia" (to end in 2019) involving both public and private actors, in Bolzano [10]. There, both building energy enhancement actions and urban "smart" actions are tested.

Positive results, including optimal levels of energy consumption and CO2 emission reduction, have been obtained from the completed building tranches. Some criticalities emerged anyway throughout the construction as works were accomplished without Tenants moving out. In some cases, the troubles faced by the occupants made it more difficult to manage the issues for the building firm.

Actually, in order to obtain collaboration from the occupants, meetings of IPES' managers, designers and Tenants had been scheduled before starting the works, to deal with the expected building and plant improvements and the resulting benefits in terms of wellbeing and lesser costs for air conditioning and hot wash water. It means that Tenants had been advised in advance. Nevertheless, as we were told by IPES' engineers, some Tenants had expressed discomfort not so much for the interferences encountered in everyday life throughout the construction period (regardless of the practical options the building firm had made available to overcome these issues) but rather because they were worried about having to learn how to use the new remote controls, valves and devices installed in their apartments. They actually perceived it as an annoying task and were apprehensive about using such devices.

3. Students-coaches to engage Tenants
Based on our surveys at the sites in Bolzano, it was clear that Tenants are not always aware of how technologically advanced a housing estate can be. Therefore, they are not consistently motivated to follow a sustainable model regarding the use of their dwelling.

This research is intended to develop a tool designed to transform Tenants from passive users into active players who will:

- become familiar about the technical solutions available in their apartment/building;
- become aware of the importance of a rational behaviour in getting best sustainability results; and
- focus their efforts to save on the running expenses (with due regard to wellbeing requirements) and to enhance their social relations and sense of community [9].

More concretely, this research aims at fostering a Tenants' involvement process by bringing in new players, to say, senior Students from technical high schools (including, secondary schools for building surveyors, vocational technical high schools, scientific high schools and equivalent), specifically trained to coach the Tenants about how to efficiently use the newly installed devices and systems and to catch the close interrelation between a rational use and costs. The idea is that of training the Tenants

through periodic meetings to be held throughout a school year (namely, the final high school year ending with a "state exam").

To help the training activity, the ASA, a dedicated sustainable housing approach application was designed as described below. A tool developed by Students and Tenants, the ASA will then remain available to Tenants.

Besides meeting the Tenants' need of getting familiar with the newly-installed devices and systems, the training path will entail great benefits for the Students alike. In point of fact, Students will have the opportunity to:

- become familiar with the most updated power consumption and pollution reduction devices;
- enter the labour market and get in touch with key players (public housing engineers, construction firm engineers, university researchers, and independent scientists);
- get a direct experience on human relations management.

In the short term, the student-coaches can take an immediate advantage of this experience as they can submit their findings within the state exam papers, at the end of their school curriculum.

4. Key Players. Steps to implement a knowledge process

Primarily designed to actively engage the Tenants in the project, this knowledge process expects that skills be exchanged among all the parties involved in a public housing building project plus – as mentioned – selected Students from technical high schools to work closely with the Tenants.

Key players include:

- 1 - Experts from public building institutions (architects, engineers, building surveyors, industrial engineers) responsible for the different design phases (preliminary, final, construction) and the site activities;
- 2 - Designers who have won a competition for public housing projects – either new or rehabilitation projects;
- 3 - Engineers from the building firms, in charge of the project steps at the site;
- 4 - Experts from public housing institutions responsible for managing the property assets (buildings and apartments);
- 5 - Tenants;
- 6 - Teachers from technical high schools;
- 7 - Senior Students from technical high schools;
- 8 - Research Team involving university researchers and independent scientists responsible for designing dedicated tools to help the knowledge process.

Skills and information will be collected and transferred from a player to another through the following steps.

4.1. Step One: Players 1 and 4

Featuring: The Experts from public building institutions (Player 1) in charge of the project preparation process in cooperation with Player 2; responsible for the supervision of all the construction steps in cooperation with Player 3; and working in close cooperation with Player 4: - will be responsible for collecting data about buildings and apartments.

Data about the Tenants (Player 5) will be made available by Player 4, and will cover:

- Sustainability performance (architectural and technological characteristics of the envelope, plant engineering solutions, information about the use of spaces and energy consumption calculated for every apartment);
- Criteria used by Tenants in managing the in-house devices and systems (temperature adjustment, forced ventilation, sunscreens etc.);
- Characteristics of the households.

4.2. Step Two: Player 8
Featuring: The Research Team, including university researchers and independent scientists (Player 8), will be responsible for (i) processing all apartment and tenant-related data collected in Step One by Players 1 and 2; (ii) assessing the results in cooperation with Player 6 that will train the Students (Player 7).

The research team will convert the data collected in Step One into contents and languages easy to understand by Tenants and compatible with the educational trail of selected Students.

Data will specifically show how the management of in-house technical devices is correlated with consumption, wellbeing and needs for maintenance. For instance:

- opening time of fixtures associated with forced ventilation for air change;
- control of thermostatic radiator valves;
- handling of sunscreens depending on the hours of the day and seasons;
- interaction with insulating layers most prone to shock damage.

Moreover, the research team will be responsible for:

- creating a coaching model to be used in the meetings; and
- conceiving and designing the ASA app to be used by Tenants as a sustainable knowledge and management tool.

4.3. Step Three: Player 6
Featuring: The Teachers from technical high schools (Player 6) will implement a specific educational trail with their Students (Player 7), based on the Step Two outcomes provided by the research team (Player 8), in cooperation with Players 1 and 2.

The educational trail will entail two phases with the participation of Teachers from different areas (technology, psychology etc.).

The first phase will be devoted to the Students' technical preparation, including expected environmental performances; morphological solutions of spaces and building envelope; types and modes of operation of the next generation devices installed in buildings and apartments.

Findings of specific cases from Step Two will be used, with special reference to the information to be incorporated into the ASA.

The second stage will be devoted to the Students' psychological and relational preparation – including how best interacting with people of all ages, from a variety of cultures, skills, interests, possible disabilities and the like, in order to spark interest, understanding of the technical explanations, and active participation [5].

4.4. Step Four: Players 7 and 5
Featuring: Senior Students (Player 7) along with Tenants (Player 5) will customize the ASA contents according to the collected information [6].

In this step, a training process will be implemented by which Tenants will learn how to behave responsibly, to say, how to use devices and systems efficiently. In addition, Tenants will learn how to help managing the common spaces in their building, and how to look after the green areas and the outer paths [4].

The training process will lay the basis for developing - at a later stage – a so called ASA Community, intended to foster dialogue among Tenants and Player 4 within a wider-scale sustainable housing collaboration.

5. ASA as a responsible knowledge and management tool
In Step Four, ASA (conceived in Step Two) will be customized according to the data obtained from selected households that might have the chance to test the ASA.

In Step Four, small groups of two-to-three Students will be created. Each group will be entrusted with one household living in a specific dwelling. Students will interact with Tenants via iPad using the data collected and transferred from a player to another in Step Three. Plenary meetings are also

scheduled with all the groups of Students and all the Tenants living in the apartments belonging to the same building complex.

To facilitate productive discussions about the impact of each occupant's behaviour on consumptions and to make easier to understand the underlying scientific principles, each group of Students along with the household assigned to it, will create Pictorial Representations (Figures**)** on iPad – to reflect:

- the characteristics of each household;
- the characteristics of each apartment;
- how the members of a specific household use the rooms.

As a matter of fact, the chance of sharing – electronically – a preferred dwelling model and suggesting sustainable behaviours can empower the Tenants to get a significant saving on the operating costs without compromising their wellbeing.

The Pictorial Representations are sets of Objects from an expandable Database, specifically created for this research. The Objects can be enlarged or reduced or isolated. The Students will combine these Objects according to the Tenants' information. This means that the Pictorial Representations are not static pictures, but logical steps of a self-managed, dynamic and flexible process resulting from a shared work of Students and Tenants as explained in more detail below [8].

The Objects include:

- Type of occupants (adult, child, teenager, elder, pet);
- Type of rooms per apartment (single bedroom, twin bedroom, master bedroom, living room, kitchen, bathroom, balcony);
- Occupant-Activity-Developed Heat combination;
- Occupant-Activity-Clothing Resistance to Heat Loss combination;
- Technical device (including thermostat, clock, heat/hot water meter) and microclimate control systems (external sunscreens, indoor curtains, trees/plants.)

5.1. First Pictorial Representation

The First Pictorial Representation to be created by Students and Tenants (Figure 1) will depict a specific household-apartment combination.

Figure 1. Implementing the process. Family household using the ASA app on iPad
to identify the rooms where each member is engaged in his/her routine activities.

Following the Tenants' information, the Students will copy all the Objects related to the household members (Type of occupant) from the Database, and paste them to the iPad.

For instance, a household can include: 1 member only; 1 couple + 1 pet; 1 couple + 1 kid; 1 couple + 1 teenager; 1 couple + 2 kids; 1 couple + 2 teenagers; 1 couple + 1 elder. Different combinations are also available.

Let's point out that the disability object is depicted with the symbol of a backpack to be carried to the shoulders of an occupant – this to show the impact of this condition on everyday life of a person who is not seen as a "disabled", but as a person who "carries a disability". By way of example, if there is a differently abled member within a household (e.g., an adult), then the "adult" object will be copied from the Database and a backpack (the "disability" object) will be added to his/her shoulders.

Following the occupants' suggestions, the Students will also copy the Objects depicting the type of rooms in an apartment and past them into the iPad. Thus, the different rooms in a flat will be identified according to the number and characteristics of the occupants and the relations among them.

All apartments should be conceived having any potential disabled occupants in mind. As a matter of fact, this feature is usually disregarded as only a few apartments (generally on the ground floor) are designed to accommodate people with motor impairment and no regulations exist about other disability conditions.

5.2. Second Pictorial Representation

The Second Pictorial Representation (Figure 2) will depict the occupants' habits as Activities performed in each room and generated heat.

According to the occupants' suggestions, the Students will copy the compatible Occupant-Activity-Developed Heat combination from the Database (note that the amount of heat developed increases when swifting from sedentary activities to physical activities; also a different amount of heat is developed by a healthy adult or a person with a slow metabolism while engaged in the same activity) and copy it to the Room where the occupants are usually engaged in a specific activity.

The display of this logic step can help understanding that any physical activity develops heat and that, in certain conditions, it would be preferable to reduce the temperature setting (with resulting financial benefits). Obviously, this kind of saving cannot be expected if there are new-borns, elders or people with motor impairment in an apartment as these occupants would need a warmer environment.
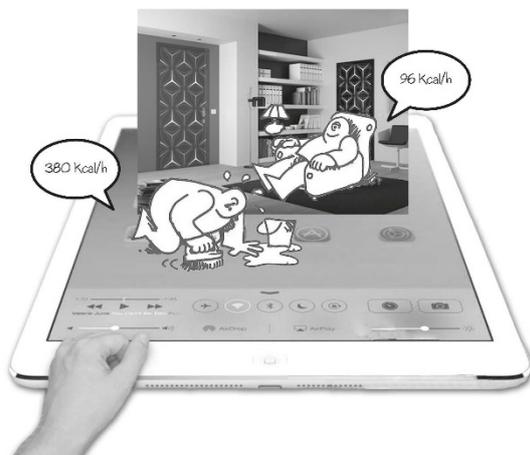
Figure 2. An ASA customization of the link between the heat generated by each occupant and the activity he/she is engaged in inside a room (heat is expressed as Kcal/h).
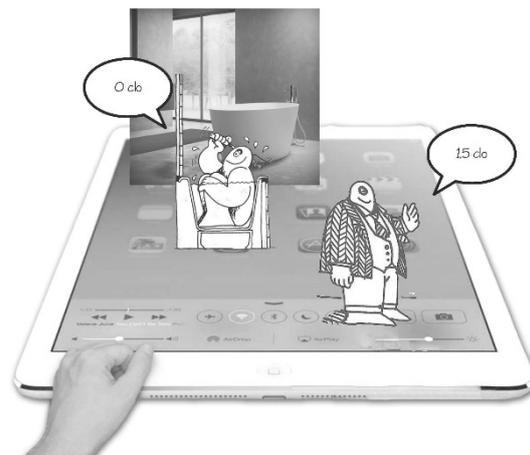
Figure 3. An ASA customization of the link between resistance to body heat loss and type of clothing (thermal resistance is expressed as clo) per occupant engaged in a specific activity in his/her apartment.

5.3. Third Pictorial Representation

The third Pictorial Representation (Figure 3) will depict the type of clothing the occupants wear and the heat resistance it offers against the loss of body heat.

Also, in this case, the occupants will provide information about their clothing habits (while engaged in routine activities in their rooms). The Students will copy the Occupant-Activity-Clothing Resistance to Heat Loss combination (for instance, a light clothing while engaged in a sedentary activity might result into discomfort, a heavy clothing while engaged in a sedentary activity might result into comfort) and copy it into the rooms where the occupants are engaged in a specific activity while usually wearing this clothing.

This Pictorial Representation will help understanding that wearing light clothing when cold is not compatible with sustainability.

By copying the results of Figures 1, 2 and 3, and pasting them into an iPad screen, the basic conditions regarding all the households living in the apartments of a building can be obtained, through pictures made up of clickable Objects available for the next steps.

5.4. Next Pictorial Representations

After customizing the items associated to every household on iPad (according to paras 5.1, 5.2, and 5.3 above), the Students will create Next Pictorial Representations. These will help the occupants understanding why using the in-house environment control devices and systems in a wise manner, compatibly with their lifestyle needs, can result into an efficient management of sustainability [3].

For instance, talking of winter time, each occupant can learn how to responsibly manage the amount of heat supplied to his/her apartment by adjusting the indoor air temperature through a thermostat.

In particular, using the previous information concerning the specific needs of a household, Students can conjecture to use the thermostat to reduce the temperature as to the basic range (20-21°C) by some degrees, for a certain number of hours:

- in some areas of a dwelling (e.g., in the night area when all people are sleeping);
- in the entire apartment (in particular, when there are no occupants inside).

Since these buildings are very well insulated, the ambient air will heat up quickly upon increasing the temperature shown on the thermostat. The extent of the consumption benefit will be determined by deducting the value that one can obtain by reducing the temperature consistently (see para. 4.4), from the heating consumption value calculated by the thermal engineer (see para. 4.1). In a real scenario, the occupant will be able to compare this data with the value recorded on the meter. This value will be then automatically sent to the managing entity that will use it for drafting the bill and forward it to the tenant's bank for payment.

This method will also be used to show how to use all the other environmental control devices and systems in a sustainable manner.

Through the display on the iPad the occupants will:

- be able to understand - in a user-friendly manner - how their apartment and their building complex do work, especially with reference to sustainability-related issues, thus being able to interact dynamically with them;
- realize how the technical solutions concerning the building will impact on the services delivered to their apartment, therefore, on their own life quality. This understanding will help developing a sense of belonging. As a matter of fact, people will become aware that having a solar panel array installed in the common areas might result into a significant reduction of the costs for hot wash water in every apartment or having photovoltaic panels arranged on the condominium surfaces might generate power for handling the lifts and lighting in public spaces, for free.

6. Conclusions

In the public building field, in spite of any significant investments that might be made to achieve a high environmental standard, new tools are anyway needed to motivate, and bring the people living in public dwellings to use any in-house microclimate adjustment devices and systems efficiently. Our research has its roots in this issue.

To this purpose, an unconventional learning and coaching process will be developed to foster the occupants' active approach based on a shared work with new players, namely, senior Students from technical high schools. The latter will coach the occupants on how to use the devices available in their dwellings in a responsible manner. Compared with a user manual which can be seen as a passive tool, the student-coach project can be regarded as a much more direct approach, and good results can be achieved, provided that on-going meetings be held throughout a school year.

This research brings in another innovation: the design of a dedicated application called ASA (the Italian acronym for Approccio Sostenibile all'Abitare), whereby the occupants will become an active player in the training process, starting from the ASA contents they will develop in close cooperation with the Students. The ASA will then be used permanently by the Tenants.

The ASA will be put available to all the occupants for free. The occupants will access the ASA through a shared iPad located in a common space of the building or, alternatively, will download it to their personal devices.

There will be significant financial benefits for all the Players, namely:

- the Tenants will get a saving in the power needed for their dwelling (cost difference vs the meter calculated value);
- the public housing institutions will get a better value from their investments (reduced maintenance charges resulting from a more collaborative behaviour from the occupants);
- the Students will expand their technical skills through contacts with key labour market Players and make a real internship experience in the field, in advance of any burdensome post-diploma training programs.

The social benefit will be even greater than the financial benefit because [7]:

- the occupants can enhance their sustainability culture including better relations with the people living in their building and their neighbourhood alike;
- the public housing institutions will progress towards the goal of establishing a community sharing a sense of belonging to a neighbourhood or a town;
- the Students will have the opportunity to make a psychological and relational experience in the management of human interactions – which is key to enrich their curricula in the short term.

Among the concrete results achieved in this research project to date, apart from the design of the knowledge process and the invention of the ASA, an animation was made to illustrate the ASA-supported training scheme [2]. This will be a useful tool to create a fundraising campaign with the goal of collecting money to develop the ASA app and starting the experimentation.

The research outcomes meet the public housing Tenants' needs in full, to say, overcoming the worries about having to learn how to adjust the environmental parameters in their apartment. Through a customized training path and the aid of student-coaches, the occupants will become active players and:

- will learn how to manage their dwelling in a sustainable manner, thus reducing power consumptions and ensuing costs;
- will be empowered to act responsibly towards the common areas and the green part, with an advantage for wellbeing and improved recreation and socialization practices.

According to future developments, the ASA can become a universal tool for use in the public building field – with significant advantages including lesser upkeep costs and improved social relations.

An extended research will then enable the Tenants to use the ASA to communicate with one another and with the public housing agency managing officers alike.

Creating an ASA Community where all Players can communicate with one another, and implementing a wider approach to sustainability will convert this technical issue into a social issue – which is the ultimate goal of this research.

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